FirstEnergy

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Akron, Ohio 44308

330-384-5151

January 20, 2000

MAILED OVERNIGHT FEDERAL EXPRESS

Mr. William Grimley/Ms. Lara Autry
Emissions Measurement Center (MD-19)
U.S. Environmental Protection Agency
Old Page Road
Research Triangle Park, NC 27711

Re: Electric Utility Steam Generating Unit Mercury Test Program

Dear Mr. Grimley and Ms. Autry:

In response to U.S. Environmental Protection Agency's (USEPA) Mercury Information Collection Request (ICR) for electric utilities, METCO Environmental conducted mercury speciation stack testing at FirstEnergy's Bruce Mansfield and Sammis Plants in late September. Final reports for both Mansfield and Sammis are enclosed in triplicate.

Please contact me at (330) 384-5744 if there are any questions.

Yours truly,

Dale Alan Kanary

Dale Alan Kanary
Director of Environmental Control
FirstEnergy Corporation

lta
Attachments

cc: Bill Hefley(Metco Environmental) - w/o enclosures
Paul Chu (EPRI) - w/o enclosures

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(972) 931-7127

SOURCE EMISSIONS SURVEY
OF
FIRSTENERGY CORPORATION
PENNSYLVANIA POWER COMPANY
BRUCE MANSFIELD POWER PLANT
UNIT NUMBER 1B SCRUBBER INLET DUCT
AND 1A STACK
SHIPPINGPORT, PENNSYLVANIA
FOR
ELECTRIC POWER RESEARCH INSTITUTE

SEPTEMBER 1999

FILE NUMBER 99-95BRM1

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1 INTRODUCTION

1.1 Summary of Test Program

METCO Environmental, Dallas, Texas, conducted a source emissions survey of FirstEnergy Corporation, Pennsylvania Power Company, Bruce Mansfield Power Plant, located in Shippingport, Pennsylvania, for the Electric Power Research Institute, on September 20, 21, and 22, 1999. The purpose of these tests was to meet the requirements of the EPA Mercury Information Request. Speciated mercury concentrations at the Unit Number 1B Scrubber Inlet Duct, speciated mercury emissions at the Unit Number 1A Stack, and mercury and chlorine content of the fuel were determined. The sulfur, ash, and Btu content of the fuel were also determined.

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, 17, and 19; in the Ontario Hydro Method, Revised July 7, 1999; and ASTM Methods Modified D2234, D6414-99, D2361-95, D-0516, D-3174, and D-3286.

1.2 Key personnel

Mr. Bill Hefley of METCO Environmental was the onsite project manager. Mr. John Pellegrine, Mr. Shane Lee, Mr. Mike Bass, Mr. Jason Conway, Mr. Scott Hart, and Mr. Jason Brown of METCO Environmental performed the testing.

Mr. Dale Kanary of FirstEnergy acted as the utility representative. Mr. Morgan Jones of FirstEnergy performed process monitoring and sampling.

The sampling was observed by Mr. Andrew A. Hetz of ETS, Inc., Mr. Adam A. Abbgy of Battelle, representing the Environmental Protection Agency; Mr. Ralph Roberson of RMB Consulting and Mr. Richard Schulz of the Energy and Environmental Research Center University of North Dakota, representing the Electric Power Research Institute. Mr. Paul Chu was the Electric Power Research Institute project manager.

Table 1-1
Test Program Organization

Organization	Individual	Responsibility	Phone Number
Project Team			
METCO	Bill Hefley	Project Manager	(972) 931-7127
METCO			
Utility			
FirstEnergy	Dale Kanary	Utility Representative	(330) 384-5744
FirstEnergy	Morgan Jones	Process Monitoring	(330) 384-5449
QA/QC			
ETS, Inc.	Andrew A. Hetz	EPA Representative	(540) 265-0131
Battelle	Adam A. Abbgy	EPA Representative	(614) 424-5484
RMB Consulting	Ralph Roberson	EPRI Representative	(919) 510-0376
EERC	Richard Schulz	EPRI Representative	(701) 777-5218
EPRI	Paul Chu	Project Manager	(650) 855-2812

2 SOURCE AND SAMPLING LOCATION DESCRIPTIONS

2.1 Process Description

Bruce Mansfield Unit Number 1 is a 780 net megawatt unit with a dry-bottom bituminous pulverized coal, wall-fired boiler. The boiler is equipped with 32 burners arranged for opposed firing in four rows of four burners each. The original Foster-Wheeler burners were replaced with Babcock & Wilcox DRB-XCL low NO_x burners with separated overfire air. Nominal steam capacity is 6,415,000 lb/hr and nominal heat input is 7,914 mmBtu/hr. The boiler was placed in operation in 1976.

2.2 Control Equipment Description

A two-stage venturi scrubber system for Bruce Mansfield Unit Number 1 was designed and furnished by Chemico. Six trains were installed, with each train consisting of a scrubber vessel, induced draft fan, and an absorber vessel. Scrubber trains 1A, 1B, and 1C exhaust through stack 1A and scrubber trains 1D, 1E, and 1F exhaust through stack 1B. The scrubber and absorber vessels are approximately 35 feet in diameter and 50 feet high. The vessels and ductwork are lined with polyester flakeglass material. The induced draft fan housing originally installed was carbon steel lined with rubber. These housings are being replaced with Incoloy 825. The induced draft fan rotors are made of Inconel 625.

The flue gas enters the top of the scrubber vessel, passes down and around an adjustable plumbob through the venturi throat, turns 180°, and passes up through a mist eliminator.

It then passes through an induced draft fan to the absorber. Pressure drop across the throat is maintained at approximately 20 inches of water. Two recycle pumps take scrubber liquor from the base of the scrubber vessel, and then pump the liquor to the top of the vessel, where the venturi throat and plumbob surfaces are wetted. Intimate mixing of the gas and liquor in the venturi throat is designed to remove practically all of the particulate matter and about 90 - 95 percent of the sulfur dioxide.

From the induced draft fan the gas enters the top of the absorber vessel, passes down through a fixed-throat venturi, turns 180°, passes through a mist eliminator, leaves the absorber vessel and enters the reheater. Absorber liquor is circulated with two recycle pumps in a manner similar to the scrubber.

The pH of the scrubber and absorber liquor is maintained at 7.5 by the addition of lime slurry to these vessels. The absorber liquor is bled from the discharge of the absorber recycle pumps for transfer to the scrubber vessel. The scrubber liquor is maintained at 8 to 10 percent solids by the addition of thickener overflow water.

2.3 Flue Gas and Process Sampling Locations

2.3.1 Inlet Sampling Location

The sampling location on the Unit Number 1B Scrubber Inlet Duct is approximately 72 feet above the ground. The sampling locations are located 20 feet (1.33 duct diameters) downstream from a bend in the duct and 12 inches (0.07 duct diameters) upstream from a bend in the duct.

2.3.2 *Stack Sampling Location*

The sampling location on the Unit Number 1A Stack is approximately 370 feet above the ground. The sampling locations are located 267 feet (14.08 stack diameters) downstream from the inlet to the stack and 583 feet (30.75 stack diameters) upstream from the outlet of the stack.

2.3.3 *Coal Sampling Location*

The coal sampling locations are located at the coal feeders immediately upstream of the coal pulverizers (P).

Figure 2-1
Description of sampling locations at Bruce Mansfield Unit Number 1B Scrubber Inlet Duct

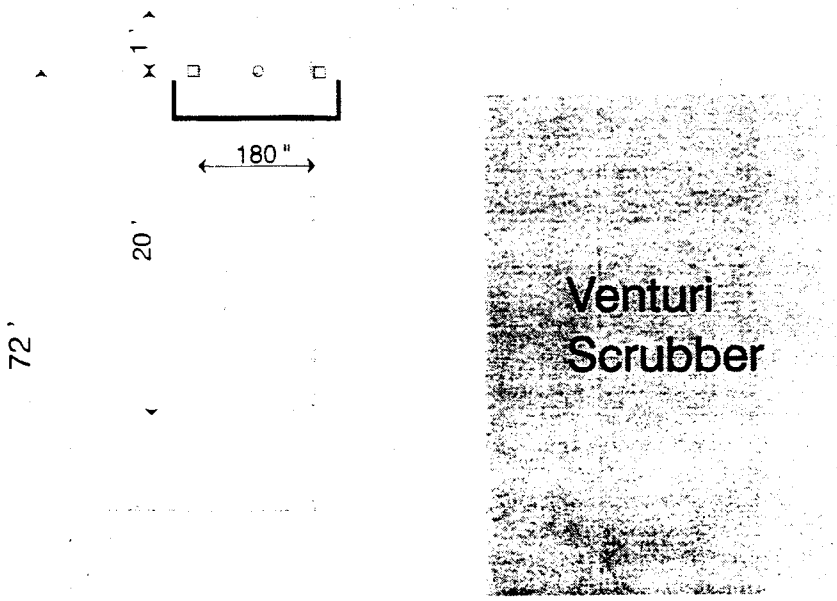
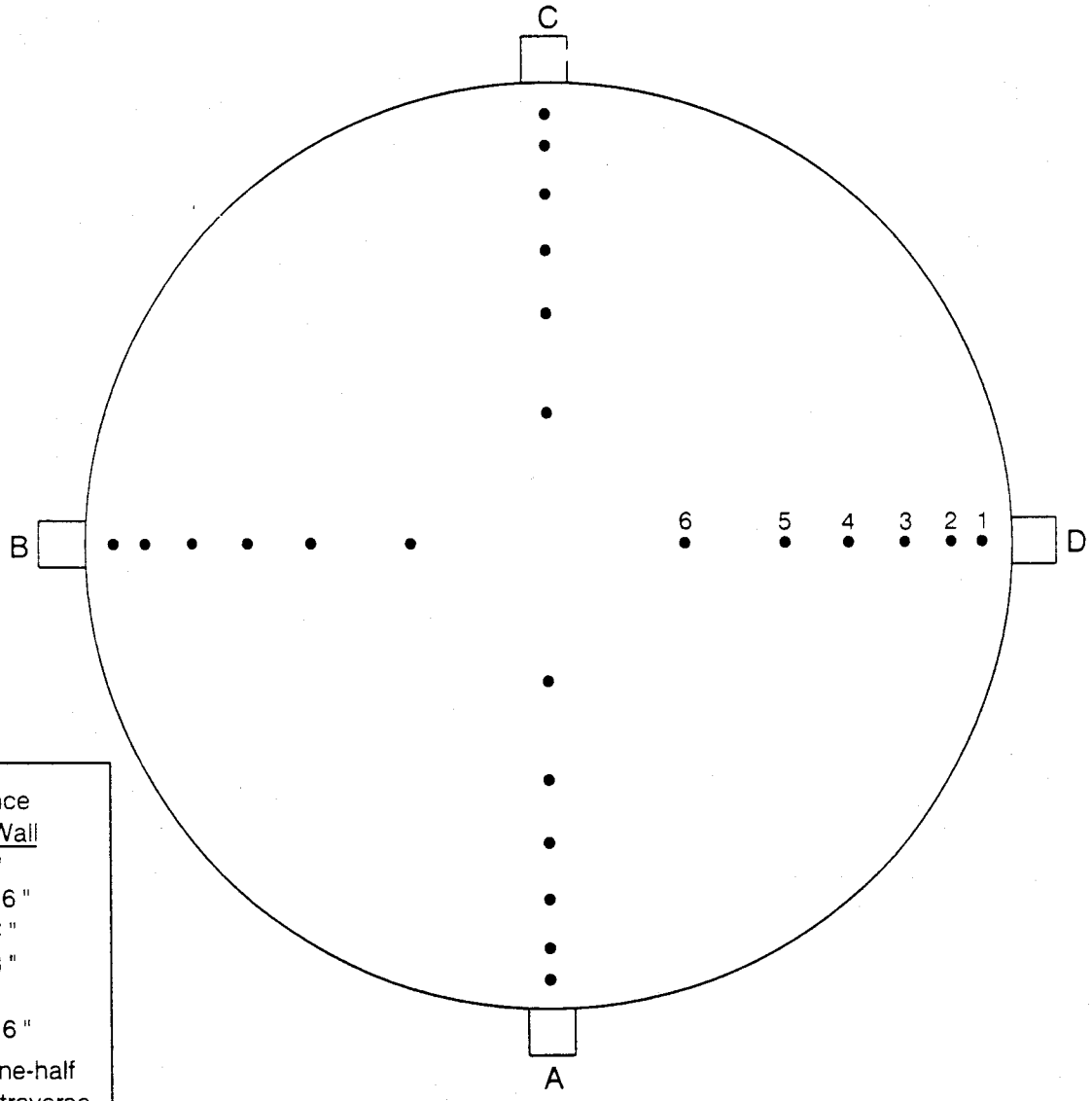


Figure 2-2
Description of sampling points at Bruce Mansfield Unit Number 1B Scrubber Inlet Duct



Point*	Distance from Wall
1	3 3/4 "
2	12 1/16 "
3	21 1/4 "
4	31 7/8 "
5	45 "
6	64 1/16 "

*Calculated as one-half of a twelve point traverse.

Figure 2-3
Description of sampling locations at Bruce Mansfield Unit Number 1A Stack

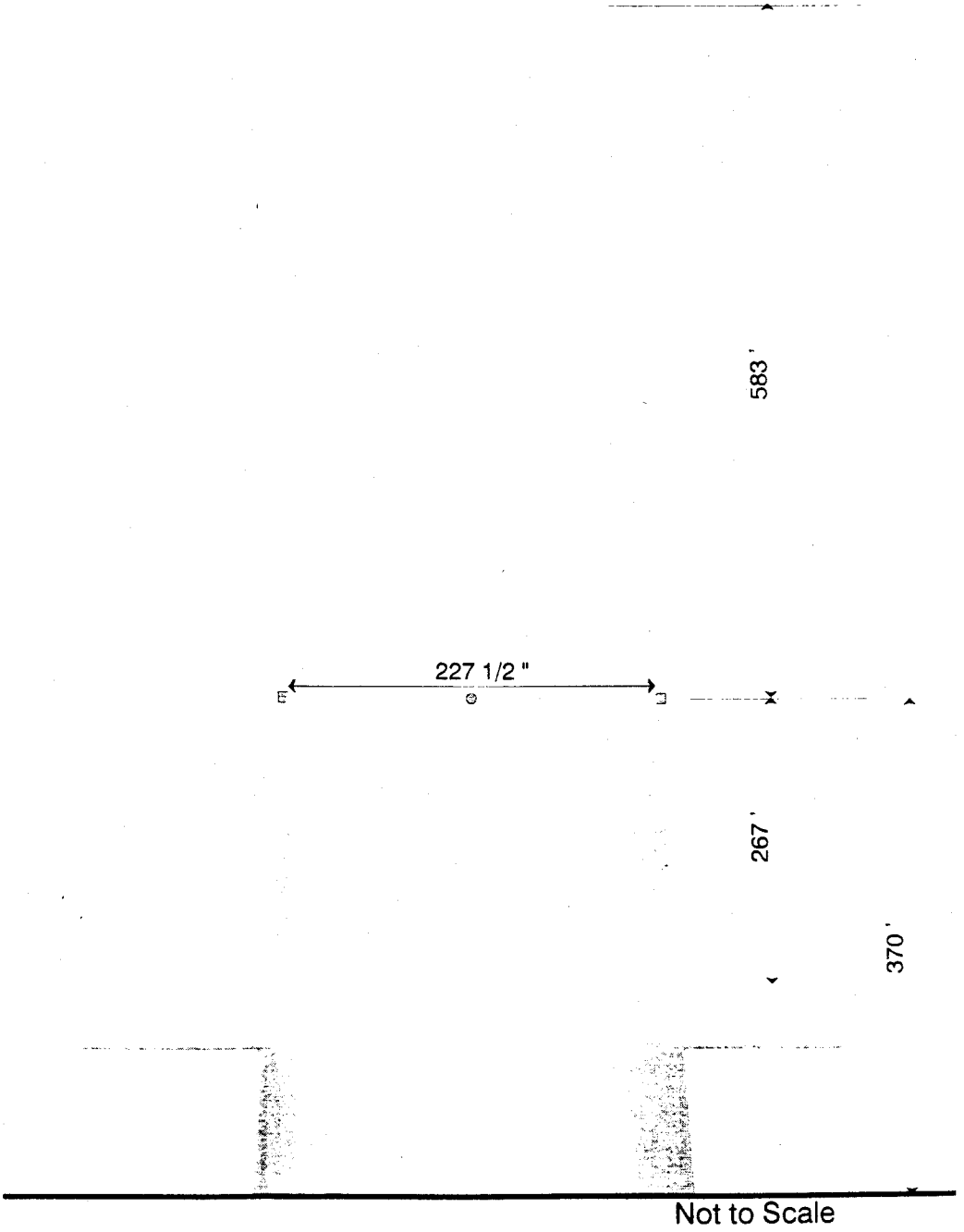
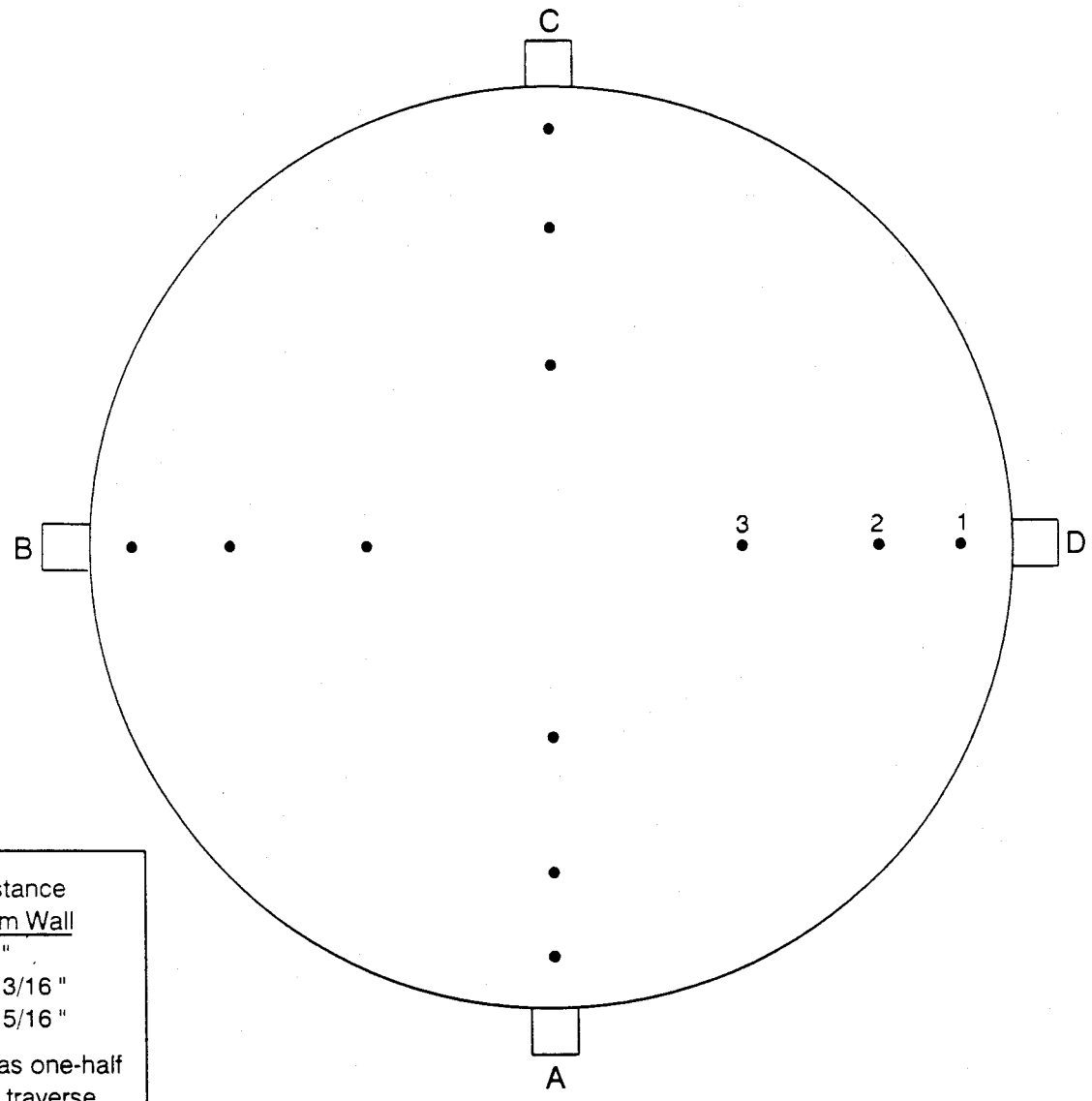


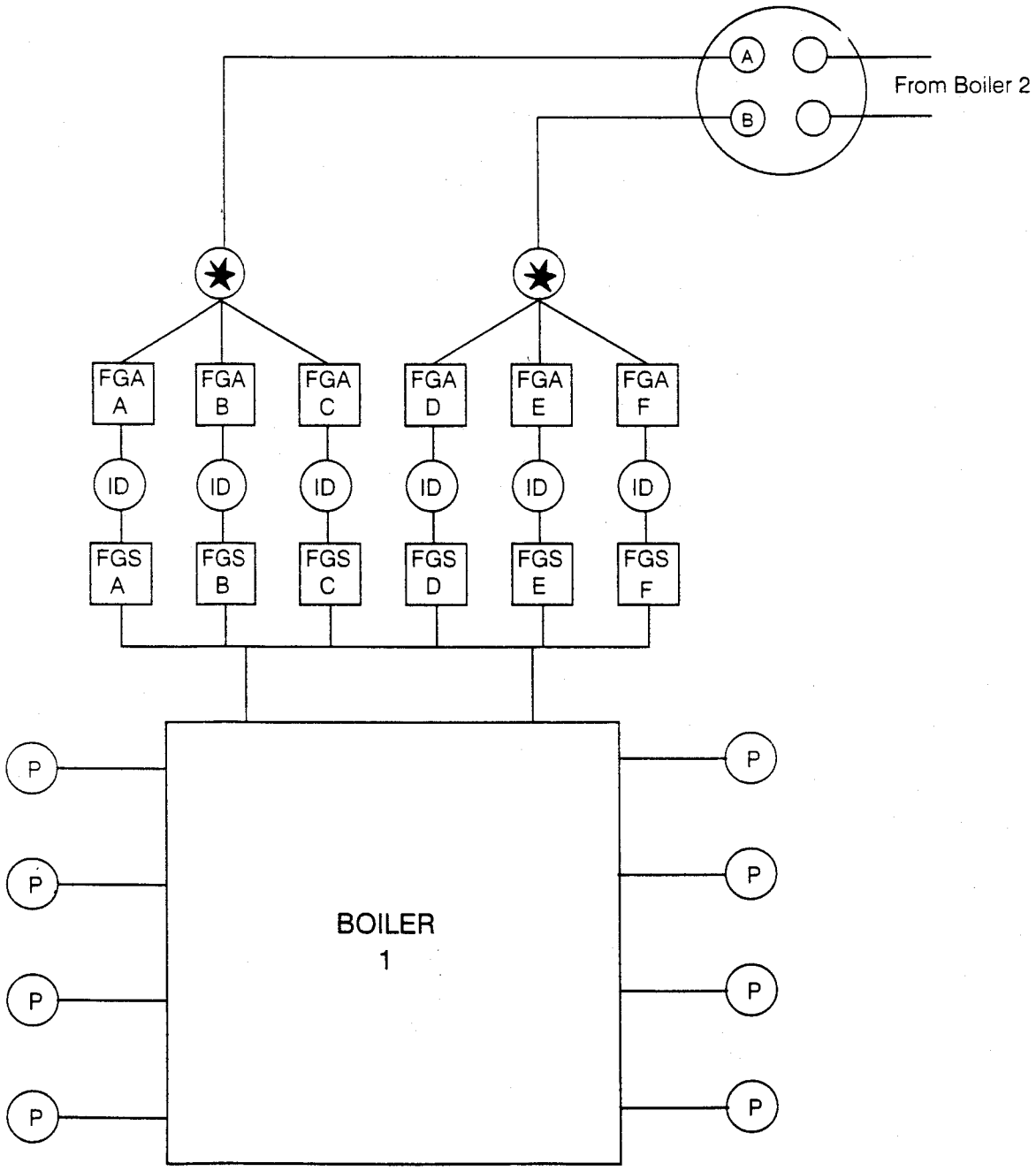
Figure 2-4
Description of sampling points at Bruce Mansfield Unit Number 1A Stack



Point*	Distance from Wall
1	10 "
2	33 3/16 "
3	67 5/16 "

*Calculated as one-half of a six point traverse.

Figure 2-5
Description of coal sampling locations at Bruce Mansfield Unit Number 1



3 SUMMARY AND DISCUSSION OF RESULTS

3.1 Objectives and Test Matrix

3.1.1 Objective

The objective of the tests was to collect the information and measurements required by the EPA Mercury ICR. Specific objectives listed in order of priority are:

1. Quantify speciated mercury emissions at the stack.
2. Quantify speciated mercury concentrations in the flue gas at the inlet.
3. Quantify fuel mercury and chlorine content during the stack and inlet tests.
4. Provide the above information for use in developing boiler, fuel, and specific control device mercury emission factors.

3.1.2 Test Matrix

The test matrix is presented in Table 1. The table includes a list of test methods to be used. In addition to speciated mercury, the flue gas measurements include moisture, flue gas flow rates, carbon dioxide, and oxygen.

Table 3-1
Test Matrix for Mercury ICR Tests at Bruce Mansfield Unit Number 1

Sampling Location	No. of Runs	Species Measured	Sampling Method	Sample Run Time	Analytical Method	Analytical Laboratory
Stack	3	Speciated Hg	Ontario Hydro	120 min	Ontario Hydro	TestAmerica
Stack	3	Moisture	EPA 4	Concurrent	Gravimetric	METCO
Stack	3	Flue Gas Flow	EPA 1 & 2	Concurrent	Pitot Traverse	METCO
Stack	3	O_2 & CO_2	EPA 3B	Concurrent	Orsat	METCO
Inlet	3	Speciated Hg	Ontario Hydro	120 min	Ontario Hydro	Test America
Inlet	3	Moisture	EPA 4	Concurrent	Gravimetric	METCO
Inlet	3	Flue Gas Flow	EPA 1 & 2	Concurrent	Pitot Traverse	METCO
Inlet	3	O_2 & CO_2	EPA 3B	Concurrent	Orsat	METCO
Coal Feeders	3	Hg, Cl, Sulfur, Ash, and Btu/lb in coal	Modified ASTM D2234	1 grab sample per mill per run	ASTM D6414-99 (Hg), ASTM D2361-95 (Cl), ASTM D-0516 (S), ASTM D-3174 (Ash), and ASTM D-3286 (Btu/lb)	TestAmerica and Philip Services

3.2 Field Test Changes and Problems

EPA Reference Method 1 procedures for Verification of Absence of Cyclonic Flow using a Type S pitot tube were not performed at Port C of the inlet sampling location. Port C was welded shut and could not be opened at the time of the cyclonic flow check. A preliminary velocity traverse was made at three of the four ports on the Unit Number 1B Scrubber Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points at Ports A, B, and D were checked for cyclonic flow and the average angle was equal to 5.1 degrees

A grab orsat sample was used for molecular weight determination for Run Number 1 at the stack sampling location. The integrated orsat sample collected during Run Number 1 was invalid due to reference method sampling equipment problems.

3.3 Summary of Results

The results of the tests performed at Bruce Mansfield Unit Number 1 are listed in the following tables. It appears that some of the oxidized mercury is being captured in the venturi scrubber and then is being released as elemental mercury. This phenomenon has been observed at other FGD sites with venturi scrubbers, however, not to the extent seen at Bruce Mansfield Unit Number 1. The Electric Power Research Institute intends to continue to evaluate the results from other sites and will follow up with the results from Bruce Mansfield Unit Number 1 as appropriate.

Table 3-2
Bruce Mansfield Unit Number 1 Source Emissions Results

Run Number	1	2	3
Test Date	09/21/99	09/21/99	09/22/99
Test Time	1130 - 1510	1722 - 2008	0900 - 1133
Inlet Gas Properties			
Flow Rate – ACFM	503,416	512,405	459,855
Flow Rate – DSCFM*	310,072	312,320	282,877
% Water Vapor - % Vol.	7.30	6.69	6.66
CO_2 - %	11.7	12.0	12.6
O_2 - %	7.1	7.0	6.3
% Excess Air @ Sampling Point	49	48	42
Temperature - °F	279	292	286
Pressure – "Hg	27.72	27.73	27.76
Percent Isokinetic	102.4	106.2	100.6
Volume Dry Gas Sampled – DSCF*	46.882	48.948	42.012
Stack Gas Properties			
Flow Rate – ACFM	1,217,127	1,213,217	1,155,458
Flow Rate – DSCFM*	897,621	895,070	878,919
% Water Vapor - % Vol.	15.37	14.75	12.76
CO_2 - %	11.4	11.7	12.0
O_2 - %	7.4	7.1	6.8
% Excess Air @ Sampling Point	52	49	46
Temperature - °F	125	127	125
Pressure – "Hg	28.78	28.68	28.80
Percent Isokinetic	98.0	98.6	98.2
Volume Dry Gas Sampled – DSCF*	62.240	62.437	61.030

* 29.92 "Hg, 68 °F (760 mm Hg, 20 °C)

Table 3-3
Bruce Mansfield Unit Number 1 Mercury Removal Efficiency

Run Number	1	2	3	Average
Test Date	09/21/99	09/21/99	09/22/99	
Test Time	1130 - 1510	1722 - 2008	0900 - 1133	
Total mercury				
Inlet - $lb/10^{12}$ Btu	7.50	9.02	7.36	7.96
Stack - $lb/10^{12}$ Btu	6.39	7.69	6.82	6.97
Removal efficiency - %	14.8	14.7	7.3	12.4
Particulate mercury				
Inlet - $lb/10^{12}$ Btu	0.20	0.52	0.20	0.31
Stack - $lb/10^{12}$ Btu	0.03	0.05	0.03	0.04
Removal efficiency - %	85.0	90.4	85.0	87.1
Oxidized mercury				
Inlet - $lb/10^{12}$ Btu	6.18	7.02	5.95	6.38
Stack - $lb/10^{12}$ Btu	1.35	1.95	0.87	1.39
Removal efficiency - %	78.2	72.2	85.4	78.2
Elemental mercury				
Inlet - $lb/10^{12}$ Btu	1.13	1.48	1.21	1.27
Stack - $lb/10^{12}$ Btu	5.01	5.69	5.92	5.54
Removal efficiency, %	-----	-----	-----	-----

Table 3-4
Bruce Mansfield Unit Number 1 Mercury Speciation Results

Run Number	1	2	3	Average
Test Date	09/21/99	09/21/99	09/22/99	
Test Time	1130 - 1510	1722 - 2008	0900 - 1133	
Inlet Mercury Speciation (Scrubber 1B)				
Particulate mercury – ug	0.284	0.784	0.267	—
ug/dscm	0.21	0.57	0.22	0.33
lb/10^{12} Btu	0.20	0.52	0.20	0.31
% of total Hg	2.7	5.8	2.7	3.7
Oxidized mercury – ug	8.87	10.60	8.10	—
ug/dscm	6.68	7.65	6.81	7.05
lb/10^{12} Btu	6.18	7.02	5.95	6.38
% of total Hg	82.4	77.8	80.8	80.3
Elemental mercury - ug	1.62	2.24	1.65	—
ug/dscm	1.22	1.62	1.39	1.41
lb/10^{12} Btu	1.13	1.48	1.21	1.27
% of total Hg	15.1	16.4	16.4	16.0
Total mercury – ug	10.77	13.62	10.02	—
ug/dscm	8.11	9.83	8.42	8.79
lb/10^{12} Btu	7.50	9.02	7.36	7.96
Stack Mercury Speciation (Stack 1A)				
Particulate mercury – ug	0.049	0.096	0.055	—
ug/dscm	0.03	0.05	0.03	0.04
lb/10^{12} Btu	0.03	0.05	0.03	0.04
% of total Hg	0.5	0.7	0.4	0.5
Oxidized mercury – ug	2.52	3.73	1.66	—
ug/dscm	1.43	2.11	0.96	1.50
lb/10^{12} Btu	1.35	1.95	0.87	1.39
% of total Hg	21.1	25.4	12.8	19.8
Elemental mercury – ug	9.34	10.88	11.30	—
ug/dscm	5.30	6.15	6.54	6.00
lb/10^{12} Btu	5.01	5.69	5.92	5.54
% of total Hg	78.4	74.0	86.8	79.7
Total mercury – ug	11.91	14.71	13.02	—
ug/dscm	6.76	8.32	7.53	7.54
lb/10^{12} Btu	6.39	7.69	6.82	6.97
Coal Analysis				
Mercury - ppm dry	0.096	0.079	0.103	0.093
Mercury - lb/10^{12} Btu	7.44	5.93	7.61	6.99
Chlorine - ppm dry	800	700	800	767
Moisture - %	5.49	5.98	5.42	5.63
Sulfur - % dry	4.29	4.54	4.60	4.48
Ash - % dry	12.1	8.57	11.2	10.6
HHV - Btu/lb as fired	12,440	12,860	12,520	12,607
Coal flow - lb/hr as fired	648,000	656,000	630,000	644,667
Total Heat Input – 10^6 Btu/hr	8,061.1	8,436.2	7,887.6	8,128.3
Total Mercury Mass Rates				
lb/hr input in coal	0.062	0.052	0.065	0.060
lb/hr at FGD inlet	0.060	0.076	0.058	0.065
lb/hr emitted	0.052	0.065	0.054	0.057

Note: Unit Number 1 consists of 2 stacks and 6 scrubbers. Scrubbers 1A, 1B, and 1C exhaust through stack 1A and scrubbers 1D, 1E, and 1F exhaust through stack 1B.

Table 3-5
Bruce Mansfield Unit Number 1 Process Data

Run Number	1	2	3
Test Date	09/21/99	09/21/99	09/22/99
Test Time	1130 - 1510	1722 - 2008	0900 - 1133
Unit Operation			
Unit Load - MW gross	849	847	849
Coal Mills in Service	B,C,E,F,G,H	B,C,D,E,F,H	B,C,D,E,G,H
Coal Flow - tons/hr	324	328	315
CEMS data			
CO_2 - % wet	10.1	10.0	10.4
SO_2 – ppm wet	89	69	112
NO_x – ppm wet	175	197	200
Stack flow - kdscfm	1,080	1,071	1,020
FGD data			
Gas outlet temperature - °F	122	121	120

4 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Emission Test Methods

The sampling followed the procedures set forth in the Code of Federal Regulations, Title 40, Chapter I, Part 60, Appendix A, Methods 1, 2, 3B, 4, 5, 17, and 19; in the Ontario Hydro Method, Revised July 7, 1999 and ASTM Methods Modified D2234, D6414-99, D2361-95, D-0516, D-3174, and D-3286.

A preliminary velocity traverse was made at three of the four ports on the Unit Number 1B Scrubber Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points at Ports A, B, and D were checked for cyclonic flow and the average angle was equal to 5.1 degrees. Port C was not accessible at the time of the cyclonic flow check. Alternate procedures would be required if the angle of cyclonic flow were greater than 20 degrees. Six traverse points were sampled from each of the four ports for a total of twenty-four traverse points at the inlet duct sampling location.

A preliminary velocity traverse was made at each of the four ports on the Unit Number 1A Stack, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points were checked for cyclonic flow and the average angle was equal to 1.1 degrees. Alternate procedures would be required if the angle of cyclonic flow were greater than 20 degrees. Three traverse points were sampled from each of the four ports for a total of twelve traverse points at the stack sampling location.

The sampling trains were leak-checked at the end of the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during each test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

Integrated orsat samples were collected and analyzed according to EPA Method 3B during each test.

4.1.1 Mercury

Triplicate samples for mercury were collected. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5 and 17; and the Ontario Hydro Method, Revised July 7, 1999. For each run, samples of five-minute duration were taken isokinetically at each of the twenty-four traverse points at the inlet sampling location and samples of ten-minute duration were taken isokinetically at each of the twelve sampling points at the stack sampling location for a total sampling time of 120 minutes. Data was recorded at five-minute intervals. Reagent blanks were submitted.

The "front-half" of the sampling train at the inlet sampling location contained the following components:

Teflon Coated Nozzle
In-stack Quartz Fiber Thimble and Backup Filter and Teflon Coated Support
Heated Glass Probe @ > 248°F

The "front-half" of the sampling train at the stack sampling location contained the following components:

Teflon Coated Nozzle
Heated Glass Probe @ > 248°F
Heated Quartz Fiber Filter and Teflon Support @ > 248°F

The "back-half" of the sampling train at both sampling locations contained the following components:

Impinger Number	Impinger Type	Impinger Contents	Amount	Parameter Collected
1	Modified Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
2	Modified Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
3	Greenburg-Smith Design	1 mol/L KCL	100 ml	Oxidized Mercury and Moisture
4	Modified Design	5% HNO_3 and 10% H_2O_2	100 ml	Elemental Mercury and Moisture
5	Modified Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
6	Modified Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
7	Greenburg-Smith Design	4% $KMnO_4$ and 10% H_2SO_4	100 ml	Elemental Mercury and Moisture
8	Modified Design	Silica	200 g	Moisture

All glassware was cleaned prior to use according to the guidelines outlined in EPA Method 29, Section 5.1.1 and the Ontario Hydro Method, Revised July 7, 1999, Section 13.2.15. All glassware connections were sealed with Teflon tape.

At the conclusion of each test, the filter and impinger contents were recovered according to procedures outlined in the Ontario Hydro Method, Revised July 7, 1999, Section 13.2.

Mercury samples were analyzed by Cold Vapor Atomic Absorption and Fluorescence Spectroscopy.

4.2 Process Test Methods

A modified ASTM D2234 method of coal sampling was followed. For each test run, a grab sample of coal was collected from each coal feeder immediately upstream of the coal pulverizers. One composite sample was prepared for analysis from the individual feeder samples. Each sample was analyzed for mercury, chlorine, sulfur, ash, and Btu content by ASTM Methods D6414-99, D2361-95, D-0516, D-3174, and D-3286 respectively.

4.3 Sample Tracking and Custody

Samples and reagents were maintained in limited access, locked storage at all times prior to the test dates. While on site, they were at an attended location or in an area with limited access. Off site, METCO and TestAmerica provided limited access locked storage areas for maintaining custody.

Chain of custody forms are located in Appendix F. The chain of custody forms will provide a detailed record of custody during sampling, with the initials noted of the individuals who load and recover impingers and filters and perform probe rinses.

All samples were packed and shipped in accordance with regulations for hazardous substances.

5 QA/QC ACTIVITIES

The major project quality control checks are listed in Table 5-1. Matrix Spike Summaries are listed in Table 5-2. Duplicate and Triplicate Analyses Summaries are listed in Table 5-3. Additional method-specific QC checks are presented in Table 5-4 (Methods 1 and 2), Table 5-5 (Method 5/17 sampling), and Table 5-6 (Ontario Hydro sample recovery and analysis). These tables also include calibration frequency and specifications.

Table 5-1
Major Project Quality Control Checks

QC Check	*Information Provided*	*Results*
Blanks		
Reagent blank	Bias from contaminated reagent	No Mercury was detected
Field blank	Bias from handling and glassware	Mercury was detected in Container 3 of the Unit Number 1A Stack Blank Train
Spikes		
Matrix spike	Analytical bias	Sample results were between 75% - 125% recovery
Replicates		
Duplicate analyses	Analytical precision	Results were < 10% RPD
Triplicate analyses	Analytical precision	Results were < 10% RPD

Table 5-2
Matrix Spike Summary

Sampling Location	*Run Number*	*Container*	*Results (ug)*	*True Value (ug)*	*Recovery (%)*
Inlet Duct	3	1A	0.94	1.04	91
Inlet Duct	3	5	6.16	6.10	101
Inlet Duct	Blank Train	3	6.29	6.05	104
Inlet Duct	Blank Train	4	4.37	4.20	104
Stack	2	5	5.70	5.85	97
Stack	3	3	7.29	7.10	103

Table 5-3
Duplicate and Triplicate Analyses Summary

Sampling Location	Run Number	Container	Results (ug)	Duplicate Results (ug)	RPD	Triplicate Results (ug)	RPD
Scrubber 1B Inlet Duct	1	1A	0.284	0.272	4.3	-----	-----
		1B	<0.01	<0.01	0	----	----
		2	<0.31	<0.31	0	----	----
		3	8.87	8.79	0.8	----	----
		4	<1.22	<1.22	0	----	----
		5	1.62	1.61	0.3	----	----
	2	1A	0.784	0.784	0	----	----
		1B	<0.01	<0.01	0	----	----
		2	<0.32	<0.32	0	----	----
		3	10.6	10.5	1.0	----	----
		4	<0.92	<0.92	0	----	----
		5	2.24	2.19	2.0	----	----
	3	1A	0.267	0.256	4.4	0.289	7.1
		1B	<0.01	<0.01	0	----	----
		2	<0.28	<0.28	0	----	----
		3	8.10	8.03	0.9	----	----
		4	<0.78	<0.78	0	----	----
		5	1.65	1.57	4.5	----	----
1A Stack	1	1A	0.049	0.051	2.8	0.051	3.8
		2	<0.40	<0.40	0	----	----
		3	2.52	2.35	6.6	----	----
		4	<0.62	<0.62	0	----	----
		5	9.34	9.29	0.6	9.29	0.6
	2	1A	0.096	0.096	0.5	----	----
		2	<0.31	<0.31	0	----	----
		3	3.73	3.78	1.3	----	----
		4	<0.90	<0.90	0	----	----
		5	10.88	10.53	1.6	----	----
	3	1A	0.055	0.055	0	----	----
		2	<0.35	0.364	8.8	----	----
		3	1.66	1.63	2.2	----	----
		4	<0.80	<0.80	0	----	----
		5	11.3	11.07	1.7	----	----

Table 5-4
QC Checklist and Limits for Methods 1 and 2

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Measurement site evaluation	>2 diameters downstream and 0.5 diameters upstream of disturbances*	Method 1, Section 2.1
Pitot tube inspection	Inspect each use for damage, once per program for design tolerances	Method 2, Figures 2-2 and 2-3
Thermocouple	+/- 1.5% (°R) of ASTM thermometer, before and after each test mobilization	Method 2, Section 4.3
Barometer	Calibrate each program vs. mercury barometer or vs. weather station with altitude correction	Method 2, Section 4.4

* Although the inlet sampling locations does not meet the requirements of EPA Method 1, three-dimensional flow testing as described in EPA Method 1 was not performed. A preliminary velocity traverse was made at three of the four ports on the Unit Number 1B Scrubber Inlet Duct, in order to determine the uniformity and magnitude of the flow prior to testing. All traverse points at Ports A, B, and D were checked for cyclonic flow and the average angle was equal to 5.1 degrees. Port C was not accessible at the time of the cyclonic flow check.

Table 5-5
QC Checklist and Limits for Method 5/17 Sampling

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Pre-mobilization checks		
Gas meter/orifice check	Before test series, Y_D +/- 5% (of original Y_D)	Method 5, Section 5.3
Probe heating system	Continuity and resistance check on element	
Nozzles	Note number, size, material	
Glassware	Inspect for cleanliness, compatibility	
Thermocouples	Same as Method 2	
On-site pre-test checks		
Nozzle	Measure inner diameter before first run	Method 5, Section 5.1
Probe heater	Confirm ability to reach temperature	
Pitot tube leak check	No leakage	Method 2, Section 3.1
Visible inspection of train	Confirm cleanliness, proper assembly	
Sample train leak check	≤0.02 cf at 15" Hg vacuum	Method 5, Section 4.1.4
During testing		
Probe and filter temperature	Monitor and confirm proper operation	
Manometer	Check level and zero periodically	
Nozzle	Inspect for damage or contamination after each traverse	Method 5, Section 5.1
Probe/nozzle orientation	Confirm at each point	
Post test checks		
Sample train leak check	≤0.02 cf at highest vacuum achieved during test	Method 5, Section 4.1.4
Pitot tube leak check	No leakage	Method 2, Section 3.1
Isokinetic ratio	Calculate, must be 90-110%	Method 5, Section 6
Dry gas meter calibration check	After test series, Y_D +/- 5%	Method 5, Section 5.3
Thermocouples	Same as Method 2	
Barometer	Compare w/ standard, +/- 0.1" Hg	

Table 5-6 QC Checklist and Limits for Ontario Hydro Mercury Speciation

Quality Control Activity	Acceptance Criteria and Frequency	Reference
Pre-mobilization activities		
Reagent grade	ACS reagent grade	Ontario Hydro Section 8.1
Water purity	ASTM Type II, Specification D 1193	Ontario Hydro Section 8.2
Sample filters	Quartz; analyze blank for Hg before test	Ontario Hydro Section 8.4.3
Glassware cleaning	As described in Method	Ontario Hydro Section 8.10
On-site pre-test activities		
Determine SO_2 concentration	If >2500 ppm, add more HNO_3-H_2O_2 solution	Ontario Hydro Section 13.1.13
Prepare KCl solution	Prepare batch as needed	Ontario Hydro Section 8.5
Prepare HNO_3-H_2O_2 solution	Prepare batch as needed	Ontario Hydro Section 8.5
Prepare H_2SO_4-$KMnO_4$ solution	Prepare daily	Ontario Hydro Section 8.5
Prepare HNO_3 rinse solution	Prepare batch as needed; can be purchased premixed	Ontario Hydro Section 8.6
Prepare hydroxylamine solution	Prepare batch as needed	Ontario Hydro Section 8.6
Sample recovery activities		
Brushes and recovery materials	No metallic material allowed	Ontario Hydro Section 13.2.6
Check for $KMnO_4$ Depletion	If purple color lost in first two impingers, repeat test with more HNO_3-H_2O_2 solution	Ontario Hydro Section 13.1.13
Probe cleaning	Move probe to clean area before cleaning	Ontario Hydro Section 13.2.1
Impinger 1,2,3 recovery.	After rinsing, add permanganate until purple color remains to assure Hg retention	Ontario Hydro Section 13.2.8
Impinger 5,6,7 recovery.	If deposits remain after HNO_3 rinse, rinse with hydroxylamine sulfate. If purple color disappears after hydroxylamine sulfate rinse, add more permangante until color returns	Ontario Hydro Section 13.2.10
Impinger 8	Note color of silica gel; if spent, regenerate or dispose.	Ontario Hydro Section 13.2.11
Blank samples		
0.1 N HNO_3 rinse solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
KCl solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
HNO_3-H_2O_2 solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
H_2SO_4-$KMnO_4$ solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
Hydroxylamine sulfate solution	One reagent blank per batch.	Ontario Hydro Section 13.2.12
Unused filters	Three from same lot.	Ontario Hydro Section 13.2.12
Field blanks	One per set of tests at each test location.	Ontario Hydro Section 13.4.1
Laboratory activities		
Assess reagent blank levels	Target <10% of sample value or <10x instrument detection limit. Subtract as allowed.	Ontario Hydro Section 13.4.1
Assess field blank levels	Compare to sample results. If greater than reagent blanks or greater than 30% of sample values, investigate. Subtraction of field blanks not allowed.	Ontario Hydro Section 13.4.1
Duplicate/triplicate samples	All CVAAS runs in duplicate; every tenth run in triplicate. All samples must be within 10% of each other; if not, recalibrate and reanalyze.	Ontario Hydro Section 13.4.1

6 DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 12:30 p.m. or. Monday, September 20, 1999. After meeting with plant personnel and attending a brief safety meeting, the equipment was moved onto the Unit Number 1B Scrubber Inlet Duct and Unit Number 1A Stack. The preliminary data was collected. The equipment was secured for the night. All work was completed at 11:00 p.m.

On Tuesday, September 21, work began at 6:00 a.m. The equipment was prepared for testing. Testing was delayed due to reference method equipment problems. The first set of tests for mercury began at 11:30 a.m. Testing continued until the completion of the second set of tests at 8:08 p.m. The samples were recovered. The equipment was secured for the night. All work was completed at 10:30 p.m.

On Wednesday, September 22, work began at 6:00 a.m. The equipment was prepared for testing. Testing was delayed due to unit operational problems. The third set of tests for mercury began at 9:00 a.m. and was completed at 11:33 a.m.

The samples were recovered. The equipment was moved off of the sampling locations and loaded into the sampling van. The samples and the data were transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operation at FirstEnergy Corporation, Pennsylvania Power Company, Bruce Mansfield Power Plant, Unit Number 1B Scrubber Inlet Duct and Unit Number 1A Stack, located in Shippingport, Pennsylvania, for the Electric Power Research Institute, were completed at 3:30 p.m. on Wednesday, September 22, 1999.

Billy J. Mullins, Jr. P.E.
President